Apprenticeship and Industry Training

Agricultural Equipment Technician

Apprenticeship Course Outline

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Alberta

Apprenticeship and Industry Training

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Apprenticeship

Apprenticeship is post-secondary education with a difference. Apprenticeship begins with finding an employer. Employers hire apprentices, pay their wages and provide on-the-job training and work experience. Approximately 80 per cent of an apprentice's time is spent on the job under the supervision of a certified journeyperson or qualified tradesperson. The other 20 per cent involves technical training provided at, or through, a post-secondary institution – usually a college or technical institute.

To become certified journeypersons, apprentices must learn theory and skills, and they must pass examinations. Requirements for certification—including the content and delivery of technical training—are developed and updated by the Alberta Apprenticeship and Industry Training Board on the recommendation of Agricultural Equipment Technician Provincial Apprenticeship Committee.

The graduate of the Agricultural Equipment Technician apprenticeship program is a certified journeyperson who will be able to:

- repair, diagnose and maintain by skill and knowledge gained through training and experience any of the working parts of diesel engines as well as the various components of mobile farm machinery
- use, competently, both hand and power tools in order to carry out repairs according to manufacturer's specifications
- read and understand work orders, prepare estimates, and interpret technical manuals
- write service reports, diagnose the cause of failures and keep service analysis records
- utilize the knowledge and may advance to service representatives or supervisory positions
- be familiar with the work in related trades such as Heavy Equipment Technician, Machinist and Welder
- perform assigned tasks in accordance with quality and production standards required by industry

Apprenticeship and Industry Training System

Industry-Driven

Alberta's apprenticeship and industry training system is an industry-driven system that ensures a highly skilled, internationally competitive workforce in more than 50 designated trades and occupations. This workforce supports the economic progress of Alberta and its competitive role in the global market. Industry (employers and employees) establishes training and certification standards and provides direction to the system through an industry committee network and the Alberta Apprenticeship and Industry Training Board. The Alberta government provides the legislative framework and administrative support for the apprenticeship and industry training system.

Alberta Apprenticeship and Industry Training Board

The Alberta Apprenticeship and Industry Training Board provides a leadership role in developing Alberta's highly skilled and trained workforce. The board's primary responsibility is to establish the standards and requirements for training and certification in programs under the Apprenticeship and Industry Training Act. The board also provides advice to the Minister of Advanced Education on the needs of Alberta's labour market for skilled and trained workers, and the designation of trades and occupations.

The thirteen-member board consists of a chair, eight members representing trades and four members representing other industries. There are equal numbers of employer and employee representatives.

Industry Committee Network

Alberta's apprenticeship and industry training system relies on a network of industry committees, including local and provincial apprenticeship committees in the designated trades, and occupational committees in the designated occupations. The network also includes other committees such as provisional committees that are established before the designation of a new trade or occupation comes into effect. All trade committees are composed of equal numbers of employer and employee representatives. The industry committee network is the foundation of Alberta's apprenticeship and industry training system.

Local Apprenticeship Committees (LAC)

Wherever there is activity in a trade, the board can set up a local apprenticeship committee. The board appoints equal numbers of employee and employer representatives for terms of up to three years. The committee appoints a member as presiding officer. Local apprenticeship committees:

- monitor apprenticeship programs and the progress of apprentices in their trade, at the local level
- make recommendations to their trade's provincial apprenticeship committee (PAC) about apprenticeship and certification in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- make recommendations to the board about the appointment of members to their trade's PAC
- help settle certain kinds of disagreements between apprentices and their employers
- carry out functions assigned by their trade's PAC or the board

Provincial Apprenticeship Committees (PAC)

The board establishes a provincial apprenticeship committee for each trade. It appoints an equal number of employer and employee representatives, and, on the PAC's recommendation, a presiding officer - each for a maximum of two terms of up to three years. Most PACs have nine members but can have as many as twenty-one. Provincial apprenticeship committees:

- Make recommendations to the board about:
    - standards and requirements for training and certification in their trade
    - courses and examinations in their trade
    - apprenticeship and certification
    - designation of trades and occupations
    - regulations and orders under the Apprenticeship and Industry Training Act
- monitor the activities of local apprenticeship committees in their trade
- determine whether training of various kinds is equivalent to training provided in an apprenticeship program in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- consult with other committees under the Apprenticeship and Industry Training Act about apprenticeship programs, training and certification and facilitate cooperation between different trades and occupations
- consult with organizations, associations and people who have an interest in their trade and with employers and employees in their trade
- may participate in resolving certain disagreements between employers and employees
- carry out functions assigned by the board

Agricultural Equipment Technician PAC Members at the Time of Publication

Mr. K. Wood	Barrhead	Presiding Officer
Mr. A. Johnson	Spruce Grove	Employer
Mr. R. Zook	Trochu	Employer
Mr. R. Johnson	Claresholm	Employee
Ms.J. Dixon	Didsbury	Employee
Mr. G. Long	Stettler	Employee

Alberta Government

Alberta Advanced Education works with industry, employer and employee organizations and technical training providers to:

- facilitate industry's development and maintenance of training and certification standards
- provide registration and counselling services to apprentices and employers
- coordinate technical training in collaboration with training providers
- certify apprentices and others who meet industry standards

Technical Institutes and Colleges

The technical institutes and colleges are key participants in Alberta's apprenticeship and industry training system. They work with the board, industry committees and Alberta Advanced Education to enhance access and responsiveness to industry needs through the delivery of the technical training component of apprenticeship programs. They develop lesson plans from the course outlines established by industry and provide technical training to apprentices.

Apprenticeship Safety

Safe working procedures and conditions, incident/injury prevention, and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of government, employers, employees, apprentices and the public. Therefore, it is imperative that all parties are aware of circumstances that may lead to injury or harm.

Safe learning experiences and healthy environments can be created by controlling the variables and behaviours that may contribute to or cause an incident or injury. By practicing a safe and healthy attitude, everyone can enjoy the benefit of an incident and injury free environment.

Alberta Apprenticeship and Industry Training Board Safety Policy

The Alberta Apprenticeship and Industry Training Board (board) fully supports safe learning and working environments and emphasizes the importance of safety awareness and education throughout apprenticeship training- in both on-the- job training and technical training. The board also recognizes that safety awareness and education begins on the first day of on-the-job training and thereby is the initial and ongoing responsibility of the employer and the apprentice as required under workplace health and safety training. However the board encourages that safe workplace behaviour is modeled not only during on-the-job training but also during all aspects of technical training, in particular, shop or lab instruction. Therefore the board recognizes that safety awareness and training in apprenticeship technical training reinforces, but does not replace, employer safety training that is required under workplace health and safety legislation.

The board has established a policy with respect to safety awareness and training:

> **The board promotes and supports safe workplaces, which embody a culture of safety for all apprentices, employers and employees. Employer required safety training is the responsibility of the employer and the apprentice, as required under legislation other than the *Apprenticeship and Industry Training Act*.**

The board's complete document on its 'Apprenticeship Safety Training Policy' is available at www.tradesecrets.alberta.ca; access the website and conduct a search for 'safety training policy'.

Implementation of the policy includes three common safety learning outcomes and objectives for all trade course outlines. These common learning outcomes ensure that each course outline utilizes common language consistent with workplace health and safety terminology. Under the title of 'Standard Workplace Safety', this first section of each trade course outline enables the delivery of generic safety training; technical training providers will provide trade specific examples related to the content delivery of course outline safety training.

Workplace Health and Safety

A tradesperson is often exposed to more hazards than any other person in the work force and therefore should be familiar with and apply the Occupational Health and Safety Act, Regulations and Code when dealing with personal safety and the special safety rules that apply to all daily tasks.

Workplace Health and Safety (Alberta Employment and Immigration) conducts periodic inspections of workplaces to ensure that safety regulations for industry are being observed.

Additional information is available at www.worksafely.org

Technical Training

Apprenticeship technical training is delivered by the technical institutes and many colleges in the public post-secondary system throughout Alberta. The colleges and institutes are committed to delivering the technical training component of Alberta apprenticeship programs in a safe, efficient and effective manner. All training providers place great emphasis on safe technical practices that complement safe workplace practices and help to develop a skilled, safe workforce.

Alberta Advanced Education, Apprenticeship and Industry Training offer your apprenticeship training program. Staff and facilities for delivering all four periods of the program are supplied by Olds College; second and fourth period are also offered at:

Keyano College
Grande Prairie Regional College
Lethbridge College
Southern Alberta Institute of Technology
Lakeland College
Northern Alberta Institute of Technology
Red Deer College
Medicine Hat College

Procedures for Recommending Revisions to the Course Outline

Advanced Education has prepared this course outline in partnership with the Agricultural Equipment Technician Provincial Apprenticeship Committee.

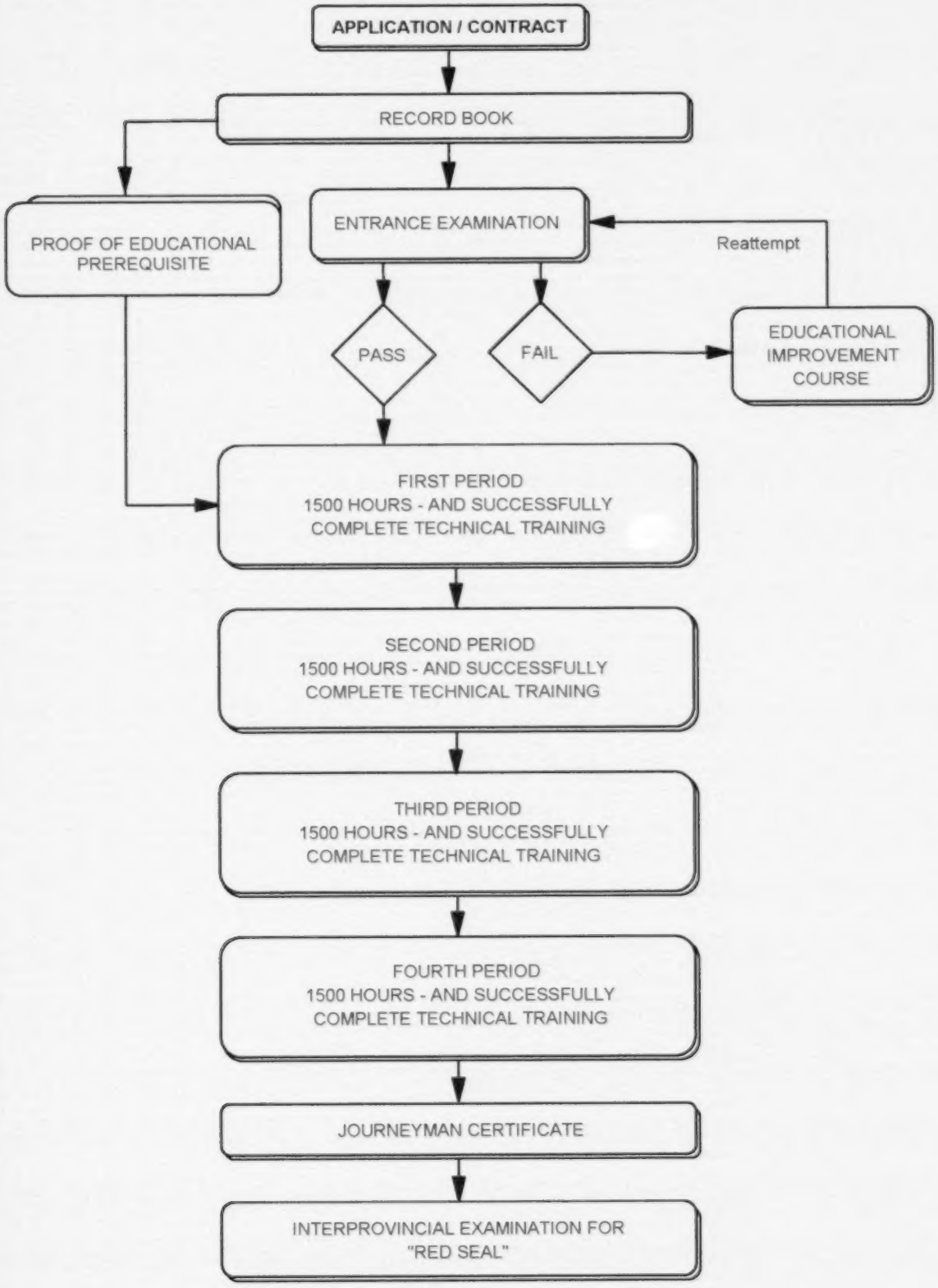
This course outline was approved on December 9, 2011 by the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. The valuable input provided by representatives of industry and the institutions that provide the technical training is acknowledged.

Any concerned individual or group in the province of Alberta may make recommendations for change by writing to:

Agricultural Equipment Technician Provincial Apprenticeship Committee
c/o Industry Programs and Standards
Apprenticeship and Industry Training
Advanced Education
10th floor, Commerce Place
10155 102 Street NW
Edmonton AB T5J 4L5

It is requested that recommendations for change refer to specific areas and state references used. Recommendations for change will be placed on the agenda for regular meetings of the Agricultural Equipment Technician Provincial Apprenticeship Committee.

Apprenticeship Route toward Certification



Agricultural Equipment Technician Training Profile
FIRST PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

STANDARD WORKPLACE SAFETY, MATERIALS & TOOLS
36 HOURS

A	B	C
Safety Legislation, Regulations & Industry Policy in the Trades 3 Hours	Climbing, Lifting, Rigging and Hosting 5 Hours	Hazardous Materials & Fire Protection 4 Hours
D	**E**	**F**
Communication 7 Hours	Materials, Fastening Devices and Sealing Systems 5 Hours	Precision Measuring Tools 8 Hours
G		
Hand Tools 4 Hours		

SECTION TWO

ELECTRIC WELDING AND OXY FUEL CUTTING
30 HOURS

A	B	C
Welding Safety 3 Hours	Oxy-Fuel Equipment 9 Hours	SMAW (Shielded Metal Arc Welding) 10 Hours
D		
GMAW (Gas Metal Arc Welding) 8 Hours		

SECTION THREE

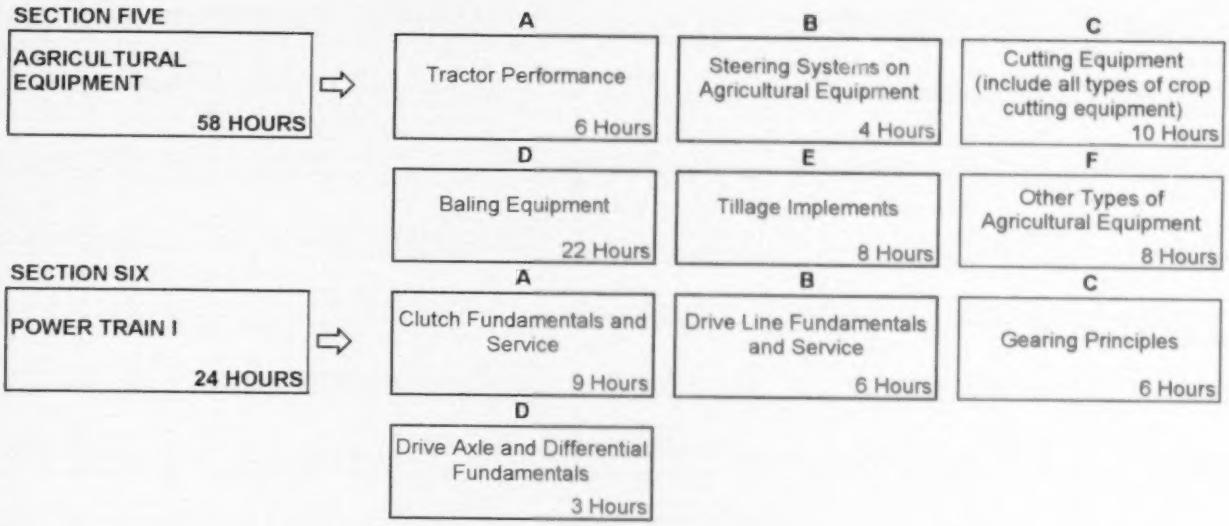
BASIC ELECTRICAL
60 HOURS

A	B	C
Electrical Fundamentals 4 Hours	Magnetism Fundamentals 4 Hours	Voltage 6 Hours
D	**E**	**F**
Electrical Current 6 Hours	Electrical Resistance 6 Hours	Introduction to Lead-acid Battery 10 Hours
G		
Diagnostic Procedures 24 Hours		

SECTION FOUR

BASIC HYDRAULICS
32 HOURS

A	B	C
Hydraulic Fundamentals 9 Hours	Hydraulic System Components: Reservoir, Filters, Hoses and Coolers 5 Hours	Hydraulic System Components: Pumps, Valves, Cylinders and Accumulators 9 Hours
D		
Hydraulic Systems 9 Hours		


SECTION FIVE
AGRICULTURAL EQUIPMENT
58 HOURS
A
Tractor Performance
6 Hours
B
Steering Systems on Agricultural Equipment
4 Hours
C
Cutting Equipment (include all types of crop cutting equipment)
10 Hours
D
Baling Equipment
22 Hours
E
Tillage Implements
8 Hours
F
Other Types of Agricultural Equipment
8 Hours
SECTION SIX
POWER TRAIN I
24 HOURS
A
Clutch Fundamentals and Service
9 Hours
B
Drive Line Fundamentals and Service
6 Hours
C
Gearing Principles
6 Hours
D
Drive Axle and Differential Fundamentals
3 Hours

SECOND PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

ENGINE FUNDAMENTALS, SERVICE AND REPAIR
75 HOURS

A	B	C
Engine Fundamentals 6 Hours	Engine Block and Cylinder Liner Fundamentals 6 Hours	Engine Block and Cylinder Liner Service 6 Hours
D	**E**	**F**
Piston, Piston Rings and Connecting Rod Fundamentals 6 Hours	Piston, Piston Rings and Connecting Rod Service 6 Hours	Crankshaft, Bearings and Related Component Fundamentals 6 Hours
G	**H**	**I**
Crankshaft, Bearings and Related Component Service 6 Hours	Camshaft and Follower Fundamentals 6 Hours	Camshaft and Follower Service 6 Hours
J	**K**	**L**
Cylinder Head Fundamentals 9 Hours	Cylinder Head Service 9 Hours	Engine Braking System Fundamentals and Service 3 Hours

SECTION TWO

ENGINE SYSTEMS
28 HOURS

A	B	C
Air Induction and Exhaust Systems 5 Hours	Turbo Charged Air Systems 5 Hours	Lubrication Systems and Crankcase Ventilation 9 Hours
D		
Cooling Systems (Liquid and Air) 9 Hours		

SECTION THREE

DIESEL FUEL INJECTION SYSTEMS
33 HOURS

A	B	C
Diesel Fuel and Storage Tanks (Machine and Bulk Storage) 3 Hours	Combustion Process and Starting Aids 4 Hours	Fuel System Service 5 Hours
D	**E**	**F**
Mechanical Fuel Injection System 6 Hours	Advanced Mechanical Fuel Injection System 9 Hours	Basic Diesel Engine and Fuel System Testing and Adjusting 1 Hour
G		
Emergency Shut Down Systems 1 Hour		

SECTION FOUR

ELECTRONICS FUEL MANAGEMENT
54 HOURS

A	B	C
Electronic Fuel System Fundamentals 15 Hours	Electronic Controlled Fuel Injection Systems 12 Hours	Electronic Fuel System Diagnosis 12 Hours
D		
Emission Control / After Treatment 15 Hours		

SECTION FIVE

HEAVY DUTY CHARGING & CRANKING SYSTEMS

50 HOURS

A	B	C
Charging System and Control Circuit Fundamentals 12 Hours	Charging System Testing and Service 18 Hours	Cranking System Fundamentals and Motor Drives 3 Hours
D	**E**	**F**
Cranking System Control Circuits 3 Hours	Cranking System Testing and Service 12 Hours	Non-Electric Cranking Systems 2 Hours

THIRD PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

SPRAYING EQUIPMENT
30 HOURS

A	B	C
Chemical Safety 6 Hours	Sprayer Systems 8 Hours	Monitoring Equipment 10 Hours

D
Suspension Systems for Spraying 6 Hours

SECTION TWO

AIR CONDITIONING AND HEATING SYSTEMS
43 HOURS

A	B	C
Air Conditioning Fundamentals 7 Hours	HVAC Control Systems 13 Hours	Air Conditioning Testing, Service and Retrofitting 23 Hours

SECTION THREE

POWER TRAIN II AND PREVENTIVE MAINTENANCE
43 HOURS

A	B	C
Hydraulic and Power Take-Off Clutches 8 Hours	Heavy Duty Transmissions and Four Wheel Drives 22 Hours	Preventative Maintenance 6 Hours

D
Failure and Fluid Analysis 7 Hours

SECTION FOUR

AGRICULTURAL HARVESTING EQUIPMENT
46 HOURS

A	B	C
Forage Harvesting Equipment 10 Hours	Combines 28 Hours	Yield Monitors 8 Hours

SECTION FIVE

BRAKING SYSTEMS
24 HOURS

A	B	C
Hydraulic Brakes System Fundamentals 4 Hours	Hydraulic Brakes Systems (Drum and Disc) 4 Hours	Hydraulic Brakes System Diagnosis and Service 4 Hours

D
Agricultural Braking Systems Fundamentals and Service 12 Hours

SECTION SIX

SEEDING AND PRECISION FARMING SYSTEMS
54 HOURS

A	B	C
GPS Mapping 12 Hours	GPS Steering Guidance Systems 7 Hours	Seeding Equipment 23 Hours

D	E
Variable Rate Application 8 Hours	Monitors and Sensors 4 Hours

FOURTH PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

HYDRAULICS II
114 HOURS

A	B	C
Hydraulic Principles 9 Hours	Hydraulic Pump Fundamentals 9 Hours	Hydraulic Pump Service 12 Hours
D	**E**	**F**
Hydraulic Actuator Fundamentals 6 Hours	Hydraulic Actuator Service 9 Hours	Hydraulic Valve II 18 Hours
G	**H**	**I**
Hydraulic System Types 18 Hours	Hydraulic System Testing and Service 18 Hours	Electro-Hydraulics 15 Hours

SECTION TWO

STEERING AND SUSPENSION SYSTEMS & ACCESSORIES (SPECIFIC TO OFF ROAD) & APPRENTICESHIP
33 HOURS

A	B	C
Wheeled Equipment Steering Fundamentals and Service 6 Hours	Suspension System Fundamentals and Service 5 Hours	Off-Road Equipment Accessories and Attachments 5 Hours
D	**E**	**F**
Off-Road Electrical Circuit Fundamentals 8 Hours	Off-Road Electrical Circuit Service 6 Hours	Workplace Coaching Skills 1 Hour
G	**H**	
Advisory Network 1 Hour	Interprovincial Standards 1 Hour	

SECTION THREE

POWER TRAIN (SPECIFIC TO OFF ROAD)
93 HOURS

A	B	C
Gearing Principles 3 Hours	Torque Converter Fundamentals and Service 9 Hours	Powershift and Automatic Transmission Mechanical/Electronic Components 14 Hours
D	**E**	**F**
Powershift and Automatic Transmission Control and Shifting 9 Hours	Hydraulic Retarder Fundamentals 3 Hours	Powershift and Automatic Transmission Testing and Service 9 Hours
G	**H**	**I**
Tracked Equipment Steering Fundamentals and Service 10 Hours	Undercarriage Systems Fundamentals and Service 11 Hours	Final Drive Fundamentals and Service (Off Road) 10 Hours
J	**K**	
Drive Axle and Differential Fundamentals and Service (Off Road) 12 Hours	Clutch Fundamentals and Service 3 Hours	

FIRST PERIOD TECHNICAL TRAINING
AGRICULTURAL EQUIPMENT TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

Due to the nature of work of the Agricultural Equipment Technician, it is imperative that safety be taught on a continuous basis throughout the entire course.

SECTION ONE: ..... STANDARD WORKPLACE SAFETY & TOOLS ..... 36 HOURS

A. Safety Legislation, Regulations & Industry Policy in the Trades .....3 Hours

Outcome: ***Describe legislation, regulations and practices intended to ensure a safe work place in this trade.***

1. Demonstrate the ability to apply the Occupational Health and Safety Act, Regulation and Code.
2. Explain the role of the employer and employee in regard to Occupational Health and Safety (OH&S) regulations, Worksite Hazardous Materials Information Systems (WHMIS), fire regulations, Workers Compensation Board regulations, and related advisory bodies and agencies.
3. Explain industry practices for hazard assessment and control procedures.
4. Describe the responsibilities of workers and employers to apply emergency procedures.
5. Describe positive tradesperson attitudes with respect to housekeeping, personal protective equipment and emergency procedures.
6. Describe the roles and responsibilities of employers and employees with respect to the selection and use of personal protective equipment (PPE).
7. Select, use and maintain appropriate PPE for worksite applications.

B. Climbing, Lifting, Rigging and Hoisting ..... 5 Hours

Outcome: ***Describe the use of personal protective equipment (PPE) and safe practices for climbing, lifting, rigging and hoisting in this trade.***

1. Select, use and maintain specialized PPE for climbing, lifting and load moving equipment.
2. Describe manual lifting procedures using correct body mechanics.
3. Describe rigging hardware and the safety factor associated with each item.
4. Select the correct equipment for rigging typical loads.
5. Describe hoisting and load moving procedures.

C. Hazardous Materials & Fire Protection ..... 4 Hours

Outcome: ***Describe the safety practices for hazardous materials and fire protection in this trade.***

1. Describe the roles, responsibilities features and practices related to the workplace hazardous materials information system (WHMIS) program.
2. Describe the three key elements of WHMIS.
3. Describe handling, storing and transporting procedures when dealing with hazardous material.
4. Describe safe venting procedures when working with hazardous materials.

5. Describe fire hazards, classes, procedures and equipment related to fire protection.

D. Communication ..... 7 Hours

Outcome: Explain techniques used to communicate service information to the customer.

1. Define standard terms used by an agricultural equipment technician.
2. Demonstrate oral and written communication as appropriate to the agricultural equipment technician.
3. Use a computer for communication and information access.
4. Demonstrate the use of service information and service bulletins as they relate to an agricultural technician.
5. Describe the requirements of the Farm Implement Act.

E. Materials, Fastening Devices and Sealing Systems ..... 5 Hours

Outcome: Identify materials, fasteners and sealing systems commonly used in the trade.

1. Describe materials and fastening devices used in agricultural machinery.
2. Demonstrate selected torquing methods.
3. Describe the safe selection, application, and storage of gaskets, sealers, adhesives and cleaners.

F. Precision Measuring Tools ..... 8 Hours

Outcome: Use precision measuring tools calibrated in imperial and metric measure.

1. Demonstrate the use of precision measuring tools.
2. Describe the care and storage of measuring tools.
3. Interpret the dimensions taken with precision measuring tools.

G. Hand Tools ..... 4 Hours

Outcome: Describe the use and maintenance of hand tools.

1. Describe the use and maintenance of selected hand tools.
2. Describe the use and maintenance of air and electrical power tools.

SECTION TWO: ..... ELECTRIC WELDING AND OXY FUEL CUTTING ..... 30 HOURS

The instruction under this section is not meant to be the level of a proficient and skilled journeyperson Welder. The intent is to train the apprentices to a level where they may operate the required equipment in a safe manner, and perform such operations of metal cutting and tack welding as to make temporary attachment of component parts, prior to the finish welding required by a certified journeyperson Welder.

A. Welding Safety .....3 Hours

Outcome: Describe methods to demonstrate personal safety.

1. Describe hazards associated with welding applications and activities.
2. Demonstrate the use of personal protective clothing and equipment.
3. Describe methods to protect other personnel in the area.

B. Oxy-Fuel Equipment .....9 Hours

Outcome: Demonstrate the use of the torch for welding, heating, brazing and cutting.

1. Describe the characteristics and safe handling procedures for gases and cylinders.
2. Describe care and maintenance procedures for oxy-fuel outfit.
3. Demonstrate equipment setup, adjustment, and shut down procedures.
4. Demonstrate use of personal protective equipment and safe operating procedures.
5. Perform heating, welding, and cutting operations using oxy-fuel equipment.
6. Describe temperature indicators and the effect of heat on metal.

C. SMAW (Shielded Metal Arc Welding) .....10 Hours

Outcome: Perform welding operations using arc welding equipment.

1. Define basic electricity terms related to SMAW welding.
2. Describe selected machine types, welding currents, and polarities.
3. Describe care and maintenance procedures of SMAW welding equipment.
4. Demonstrate equipment setup and adjustments.
5. Describe the electrode designation system.
6. Select electrodes for specific applications.
7. Describe arc welding puddle controls.
8. Demonstrate joint preparation and fit up.
9. Demonstrate use of personal protective equipment and safe operating procedures.
10. Perform basic welding techniques (single and multi pass fillets in horizontal and flat positions) using arc welding equipment.

D. GMAW (Gas Metal Arc Welding) .....8 Hours

Outcome: Perform welding operations using the MIG welding process.

1. Describe GMAW welding components and process.
2. Describe GMAW welding puddle controls.

3. Describe care and maintenance of GMAW welding equipment.
4. Demonstrate set up and adjustment procedures for GMAW welding.
5. Perform fillet welds on light gauge plate using the GMAW welding process.

SECTION THREE: ..... BASIC ELECTRICAL ..... 60 HOURS

NOTE: All electrical training is to emphasize trouble shooting and the reading of schematics.

A. Electrical Fundamentals ..... 4 Hours

Outcome: Apply scientific principles to explain electrical theory.

1. Explain the physical properties of conductors, insulators and semi-conductors.
2. Explain electricity in terms of voltage, current and resistance.

B. Magnetism Fundamentals ..... 4 Hours

Outcome: Apply scientific principles to explain the theory of magnetism.

1. Explain the fundamental laws of magnetism.
2. Explain the properties and applications of permanent magnets.
3. Explain the construction, operation, and applications of electromagnets.
4. Explain the principles of electromagnetic induction.

C. Voltage ..... 6 Hours

Outcome: Use electrical test equipment to measure electrical voltage.

1. Explain the construction and operation of voltmeters.
2. Measure electrical voltage.
3. Calculate and measure voltage drops in electrical circuits.
4. Demonstrate safe operation of voltmeters.

D. Electrical Current ..... 6 Hours

Outcome: Use electrical test equipment to measure electrical current (amperes).

1. Calculate electrical amperage.
2. Explain the construction and operation of ammeters.
3. Measure electrical current.
4. Demonstrate precautions while using ammeters.

E. Electrical Resistance ..... 6 Hours

Outcome: Use electrical test equipment to measure electrical resistance (ohms).

1. Calculate electrical resistance.
2. Explain the construction operation of ohmmeters.
3. Use an ohmmeter to measure electrical resistance.
4. Demonstrate precautions while using ohmmeters.

F. Battery Fundamentals and Service ..... 10 Hours

Outcome: Service, test and storage of agricultural batteries.

1. Identify hazards encountered with the use of batteries.
2. Explain battery construction, sizing and capacity.
3. Perform battery maintenance and testing.
4. List safety precautions and procedures for boosting batteries.
5. List safety precautions and procedures for charging batteries.
6. Explain multiple battery circuits in relation to connections and battery compatibility.

G. Diagnostic Procedures ..... 24 Hours

Outcome: Interpret electrical circuit schematics.

1. Identify commonly used schematic symbols.
2. Explain simple electrical schematic drawings.
3. Identify commonly used electrical weather and non-weather sealed connections.
4. Demonstrate wiring and connection repairs.
5. Use appropriate test equipment to test simple machine circuits.
6. Explain precautions related to accessories and electronics when servicing electrical circuits.

SECTION FOUR: ..... BASIC HYDRAULICS ..... 32 HOURS

A. Hydraulic Fundamentals ..... 9 Hours

Outcome: Explain hydraulic principles used on agricultural equipment.

1. Define hydraulic terminology.
2. Using mathematical calculations, explain the hydraulic principles of pressure, force, area, volume, flow rate, cycle times and power.
3. Draw and interpret basic hydraulic schematics.
4. State the safety precautions that must be observed when working with hydraulic systems.

B. Hydraulic System Components: Reservoir, Filters, Hoses and Coolers ..... 5 Hours

Outcome: Explain the function of the following hydraulic system components; hydraulic oils, reservoirs, filters, conductors, and heat exchangers.

1. Explain the properties of hydraulic fluid and the criteria for its selection.
2. State the functions of the hydraulic reservoir and its related components.
3. State the functions and principles of operation of filtration devices.
4. Explain the construction and applications of common types of hydraulic conductors.
5. State the functions and applications of hydraulic heat exchangers.

C. Hydraulic System Components: Pumps, Valves, Cylinders and Accumulators ..... 9 Hours

Outcome: Explain the functions and principles of operation of hydraulic system components.

1. Explain hydraulic sealing methods.
2. Explain selected pump operating principles.

3. Explain the function and principles of operation for a direct acting pressure relief valve.
4. Explain the principles of operation and applications of hydraulic control valves.
5. Explain the principles of operation and applications of hydraulic cylinders.
6. Explain the principles of operation and applications of hydraulic accumulators.

D. Hydraulic Systems ..... 9 Hours

Outcome: ***Explain the fundamental operating characteristics of hydraulic systems used in agricultural equipment.***

1. Explain the operating principles of an open centre hydraulic system.
2. Explain the operating principles of a closed centre hydraulic system.
3. Explain the operating principles of a closed centre load sensing hydraulic system.
4. Perform selected hydraulic cylinder repair.
5. Perform a basic hydraulic system pressure and flow test.

SECTION FIVE: ..... AGRICULTURAL EQUIPMENT ..... 58 HOURS

A. Tractor Performance ..... 6 Hours

Outcome: ***Identify factors that influence tractor field performance.***

1. Define tractor horsepower concepts.
2. Calculate drawbar horsepower requirements.
3. Describe and calculate slippage.
4. Describe Power Hop and its control.
5. Calculate ballasting solutions for tractors.
6. Compare the use of tires and rubber tracks.
7. Interpret Nebraska test results.

B. Steering Systems on Agricultural Equipment ..... 4 Hours

Outcome: ***Explain steering systems on agricultural equipment.***

1. Describe selected steering systems designs used on wheeled agricultural equipment.
2. Describe service of wheels, tires, and hubs.

C. Cutting Equipment (Include All Types of Crop Cutting Equipment) ..... 10 Hours

Outcome: ***Describe and adjust cutting equipment.***

1. Describe the operation of a reciprocating knife mower.
2. Perform adjustments and repairs to a reciprocating knife mower.
3. Describe the operation of a rotary disc mower.
4. Perform adjustments and repairs to a disc type mower.
5. Describe types of hay conditioners.
6. Perform adjustments to hay conditioners.
7. Identify reel types and components.
8. Describe adjustments to reels.

D. Baling Equipment ..... 22 Hours

Outcome: Describe and adjust hay baling equipment.

1. Describe the basic procedure of dry hay production.
2. Describe operation and construction of fixed chamber balers.
3. Describe operation and construction of variable chamber balers.
4. Describe operation and construction of balers used for haylage.
5. Perform adjustments and repairs to round balers.
6. Adjust baler monitor systems.
7. Describe operation and construction of small square balers.
8. Perform adjustments and repairs to small square balers.
9. Perform adjustments to knotters.
10. Describe operation and construction of large square balers.
11. Describe adjustments to large square balers.
12. Describe baler accessories.

E. Tillage Implements ..... 8 Hours

Outcome: Describe the components and usage of selected types of tillage equipment.

1. Define common tillage terms.
2. Describe tillage practices.
3. Describe types and components of ground engaging tools.
4. Analyze the levelling controls used on ground engaging tools.
5. Describe the shank protection used on ground engaging tools.
6. Explain the operation of disc implements.
7. Describe selected ground pressure systems.

F. Other Types of Agriculture Equipment ..... 8 Hours

Outcome: Describe adjustments and repairs of other selected types of equipment.

1. Describe selected short-line and materials-handling equipment.
2. Describe the operation and adjustment of selected three point hitch categories.
3. Describe the installation and inspection of agricultural loaders and frames.

SECTION SIX: ..... POWER TRAIN I ..... 24 HOURS

A. Clutch Fundamentals and Service ..... 9 Hours

Outcome: Service and diagnose common clutch types.

1. Explain the function and operating principles of spring loaded clutch systems.
2. State the function of spring loaded clutch components.
3. Diagnose spring loaded clutch systems.
4. Perform service procedures for spring loaded friction clutches.
5. Explain the operation and maintenance of over-centre clutches.

6. Explain the operation principles of overrunning, dog, cone and bevel clutches.
7. Explain the operating principles of electromagnetic clutches.

B. Drive Line Fundamentals and Service ..... 6 Hours

Outcome: Diagnose and service drive lines and universal joints.

1. Explain the function and operating principles of common drive line assemblies.
2. Explain the construction and design features of common drive line components.
3. Diagnose and service universal joints.
4. Explain driveline phasing and angle limitations.
5. Evaluate drive line phasing and angles.

C. Gearing Principles ..... 6 Hours

Outcome: Explain basic gearing principles.

1. Define gear terminology.
2. Explain gear relationships with regards to ratios and input/output direction.
3. Identify common gear types and applications.
4. Identify and calculate speed and torque relationships in single reduction planetaries.

D. Drive Axle and Differential Fundamentals ..... 3 Hours

Outcome: Explain the functions and operating principles of mechanical front wheel assist drive axle assemblies.

1. State the functions of a drive axle assembly.
2. Identify single reduction drive axle configurations.
3. Explain common axle shaft configurations.

SECOND PERIOD TECHNICAL TRAINING
AGRICULTURAL EQUIPMENT TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE:..... ENGINE FUNDAMENTALS, SERVICE AND REPAIR ..... 75 HOURS

A. Engine Fundamentals ..... 6 Hours

Outcome: ***Explain the operating principles and design features of two and four stroke internal combustion engines.***

1. Explain the stages of development of the internal combustion engine.
2. Explain common engine terms and definitions.
3. Explain common methods of classifying engines.
4. Explain the principles of operation for two and four stroke cycle engines.
5. Compare diesel and gasoline engine operation.

B. Engine Block and Cylinder Liner Fundamentals..... 6 Hours

Outcome: ***Describe the functions and design features of cylinder block assemblies.***

1. State the functions of the engine cylinder block.
2. Identify cylinder block construction and design features.
3. Describe the construction and design features of removable cylinder liners.

C. Engine Block and Cylinder Liner Service ..... 6 Hours

Outcome: ***Inspect an engine block assembly for serviceability.***

1. Inspect engine block for cracks, thread, bearing bore and machined surface condition.
2. Explain cylinder block repair procedures for cracks, threads, bearing bores and machined surfaces.
3. Explain inspection and reconditioning procedures for a cylinder block with integral cylinders.
4. Perform removable cylinder liner service.

D. Piston, Piston Rings and Connecting Rod Fundamentals..... 6 Hours

Outcome: ***Describe the functions and design features of pistons, piston rings and connecting rods.***

1. Explain the function, construction and design features of pistons and piston pins.
2. Explain the function, construction and design features of piston rings.
3. Explain the function, construction and design features of connecting rods.

E. Piston, Piston Rings and Connecting Rod Service ..... 6 Hours

Outcome: Service a piston and connecting rod assembly.

1. Remove and disassemble piston and connecting rod assemblies.
2. Inspect piston and pin for reuse.
3. Explain connecting rod service procedures.
4. Install piston and connecting rod assemblies.

F. Crankshaft, Bearings and Related Component Fundamentals ..... 6 Hours

Outcome: Describe the functions and design features of crankshafts and their related components.

1. Explain the function and design features of crankshafts.
2. Explain methods used to achieve engine balance.
3. State the functions of crankshaft seals, gears and flywheels.
4. Describe the function and design features of friction bearings specific to engines.
5. Explain the lubrication principles of engine friction bearings.

G. Crankshaft, Bearings and Related Component Service ..... 6 Hours

Outcome: Service crankshafts, friction bearings and related components.

1. Remove crankshaft and bearings from an engine block.
2. Inspect and measure crankshafts to determine serviceability.
3. Inspect flywheel and vibration damper to determine serviceability.
4. Identify common crankshaft and bearing failures.
5. Install crankshafts and related components.

H. Camshaft and Follower Fundamentals ..... 6 Hours

Outcome: Describe the functions and design features of camshafts and related components.

1. Explain the function and design features of camshafts, camshaft bearings and seals.
2. Explain the function and design features of camshaft followers.
3. Explain camshaft drive mechanisms and timing.

I. Camshaft and Follower Service ..... 6 Hours

Outcome: Service camshaft and related components.

1. Remove camshaft and related components from an engine block.
2. Inspect and measure camshafts and related components to determine serviceability.
3. Install camshaft and related components.

J. Cylinder Head Fundamentals ..... 9 Hours

Outcome: Describe the functions and design features of cylinder heads and valve train components.

1. Explain the function, construction and design features of cylinder heads.
2. Describe the construction and design features of engine valves and related components.
3. Describe the construction and design features of valve train components.
4. Identify cylinder head sealing and retention devices.

K. Cylinder Head Service ..... 9 Hours

Outcome: Service cylinder heads and valve train components.

1. Demonstrate cylinder head removal and disassembly.
2. Clean and inspect cylinder heads.
3. Explain cylinder head and valve reconditioning procedures.
4. Inspect valve train components.
5. Demonstrate cylinder head assembly and installation.

L. Engine Braking System Fundamentals and Service ..... 3 Hours

Outcome: Explain the operation of engine compression and exhaust brakes.

1. State the function of an engine brake.
2. Explain the operation of an engine compression brake.
3. Explain basic adjustment and diagnosis of an engine compression brake.
4. Explain the functions and operation of an engine exhaust brake.

SECTION TWO: ..... ENGINE SYSTEMS ..... 28 HOURS

A. Air Induction and Exhaust Systems ..... 5 Hours

Outcome: Service air induction, exhaust systems and related components.

1. State the functions of an air induction system.
2. Identify and state the function of air induction system components.
3. State the function of an exhaust system.
4. Identify and explain the operation of exhaust system components.
5. Explain the service procedures for air induction and exhaust systems.
6. Explain the use of test equipment to measure air inlet restriction and exhaust backpressure.

B. Turbo Charged Air Systems ..... 5 Hours

Outcome: Service turbo charged air induction systems.

1. State the purposes for turbo charging the engine air induction system.
2. Explain the construction and operation of a turbo charged air induction system and components.
3. Test, inspect and service a turbocharger.

4. Explain the function, construction and testing procedures for typical aftercoolers/intercoolers.
5. Explain the function of variable displacement turbo technology and wastegate systems.

C. Lubrication Systems and Crankcase Ventilation ..... 9 Hours

Outcome: Service lubrication systems and related components.

1. State the functions and characteristics of engine oil.
2. Describe the use of oil analysis as a diagnostic tool.
3. Explain the operating principles of a typical lubrication system and related components.
4. State the purpose of crankcase ventilation systems.
5. Perform lubrication system inspection and service.
6. Diagnose and repair faults related to lubrication systems and components.

D. Cooling Systems (Liquid and Air) ..... 9 Hours

Outcome: Service liquid and air-cooling systems and related components.

1. Explain the function of the engine cooling system.
2. Explain the operation and maintenance of an air-cooling system.
3. Explain the operation of a typical liquid cooling system and its components.
4. Perform engine liquid cooling system repair and maintenance.
5. Explain the functions and design features of temperature sensors and warning devices.

SECTION THREE: ..... DIESEL FUEL INJECTION SYSTEMS ..... 33 HOURS

A. Diesel Fuel and Storage Tanks (Machine and Bulk Storage) ..... 3 Hours

Outcome: Handle and store diesel fuel using safe and efficient practices.

1. State the safety precautions, characteristics and properties of diesel fuel.
2. Explain diesel fuel storage concerns.
3. Identify construction requirements and design features of fuel storage and supply tanks.

B. Combustion Process and Starting Aids ..... 4 Hours

Outcome: Apply the theory of the combustion process to engine operation and diagnosis.

1. Explain the characteristics and factors affecting the diesel engine combustion process.
2. Explain diesel engine emission concerns.
3. Identify and state the purpose of common combustion chambers.
4. Identify types and function of common diesel engine starting aids.

C. Fuel System Service ..... 5 Hours

Outcome: Explain the operation of a basic fuel injection system.

1. Identify types and service procedures for common fuel filters.
2. Explain the operating principles and design features of common fuel transfer pumps.
3. Perform testing and diagnosis of a fuel transfer system.
4. Explain fuel transfer pump inspection and service procedures.

D. Basic Mechanical Fuel Injection System ..... 6 Hours

Outcome: Explain the operation of a basic fuel injection system.

1. List the requirements of a fuel injection system.
2. Identify the layout and components of a basic fuel injection system.
3. Explain the function of the components required in the basic diesel fuel injection system.

E. Advanced Mechanical Fuel Injection System ..... 9 Hours

Outcome: Explain the operation of an advanced fuel injection system.

1. Explain the testing and timing procedures of port and helix fuel metering.
2. Explain the testing and timing procedures of inlet fuel metering for opposed plunger pump designs.
3. Explain the operating principles of hydraulic fuel injection nozzles.
4. Explain governor operation according to design characteristics and application.
5. Explain the benefits of maintaining engine adjustments.
6. Explain engine performance testing and demonstrate diagnosis.

F. Basic Diesel Engine and Fuel System Testing and Adjusting ..... 5 Hours

Outcome: Explain basic testing and adjustment procedures on diesel engines and mechanical fuel injection systems.

1. Explain the benefits of maintaining engine adjustments.
2. Explain engine performance testing and demonstrate diagnosis.

G. Emergency Shut Down Systems ..... 1 Hour

Outcome: Explain the operating principles of engine shutdown and warning systems.

1. Explain the operation of an engine emergency warning and shut down systems that monitors oil pressure, coolant temperature, coolant level and engine over-speed.

SECTION FOUR: ..... ELECTRONICS FUEL MANAGEMENT ..... 54 HOURS

A. Electronic Fuel System Fundamentals ..... 15 Hours

Outcome: Retrieve and interpret basic diagnostic information from a typical diesel engine electronic control system.

1. Explain the operation of a computer controlled fuel injection system.
2. Explain the operation of engine sensors that measure pressure, temperature, speed, fluid level, and throttle position.
3. Explain integral warning, shutdown and fault codes systems used with electronic controls.
4. Demonstrate the use of a Personal Computer (PC) and other appropriate tools for electronic system interface.
5. Demonstrate the adjustment of electronic fuel control system parameters.

B. Electronically Controlled Fuel Injection Systems ..... 12 Hours

Outcome: Identify and explain components of electronically controlled fuel injection systems.

1. Explain the operation of an electronic unit fuel injection system.

2. Explain the operation of a HEUI fuel injection system.
3. Explain the operation of a common rail fuel injection system.
4. Explain the operation of an electronic unit pump fuel injection system.

C. Electronic Fuel System Diagnosis ..... 12 Hours

Outcome: Diagnose and service electronic controlled diesel fuel injection systems.

1. Diagnose and repair an electronic fuel control system malfunction.
2. Demonstrate removal and installation procedures of an electronic fuel pump or injector.

D. Emission Control/After Treatment Systems ..... 15 Hours

Outcome: Explain the operation of emission control systems.

1. State the purposes of an emission control system to Environmental Protection Agency (EPA) guidelines.
2. Describe the theory of Exhaust Gas Recirculation (EGR)
3. Explain the purpose of Diesel Oxidation Catalyst (DOC) and Diesel Particulate Filter (DPI).
4. Explain the purpose of a Selective Catalyst Reduction (SCR) and Diesel Exhaust Fluid (DEF).
5. Discuss emerging technologies.
6. Explain effect on other vehicle systems; fuel, oil, coolants, intake/turbo systems.

SECTION FIVE: ..... HEAVY DUTY CHARGING & CRANKING SYSTEMS ..... 50 HOURS

A. Charging System and Control Circuit Fundamentals ..... 12 Hours

Outcome: Explain the operation of 12 and 24 volt charging systems.

1. Explain the purpose of the charging system in relation to equipment operation.
2. Identify charging system components.
3. Describe the operational characteristics of an alternator.
4. Identify and state the function of common alternator components.
5. Describe the operation of an alternator in regards to induction, rectification and output control.
6. Identify and state the function of common alternator components.
7. Identify common regulator types and designs.
8. State the purpose of auxiliary terminals on integrally regulated alternators.
9. Explain the operation of charging system indicator circuits.

B. Charging System Testing and Service ..... 18 Hours

Outcome: Diagnose and service 12 and 24 volt charging systems.

1. Perform on-equipment charging system tests.
2. Demonstrate the procedure to test an alternator for output and voltage control.
3. Identify alternator defects.
4. Demonstrate charging system maintenance procedures.

C. Cranking System Fundamentals and Motor Drives ..... 3 Hours

Outcome: Explain the operation of 12 and 24 volt cranking systems.

1. Identify components of a typical cranking system.
2. Describe the principles of operation of a cranking motor.
3. Identify cranking motor construction in regards to electrical design.
4. Identify and state the function of common cranking motor components.
5. Identify and explain the operation of overrunning clutch type motor drives.
6. Explain operational limitations of a cranking motor.

D. Cranking System Control Circuits ..... 3 Hours

Outcome: Explain the operation of cranking motor control circuits.

1. Trace a starting system circuit diagram.
2. Explain the operation of a cranking motor solenoid switch.
3. Explain the operation of a magnetic switch.

E. Cranking System Testing and Service ..... 12 Hours

Outcome: Diagnose and service cranking systems.

1. Perform on-equipment cranking system diagnostics.
2. Identify cranking motor defects by no-load test results.
3. Diagnose possible cranking system failures from specific symptoms.

F. Non-Electric Cranking Systems ..... 2 Hours

Outcome: Service and maintain air and hydraulic cranking systems.

1. State the function, system requirements and troubleshooting procedures required on air cranking systems.
2. State the function, system requirements and troubleshooting procedures required on hydraulic motor cranking systems.

THIRD PERIOD TECHNICAL TRAINING
AGRICULTURAL EQUIPMENT TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

Due to the nature of work of the Agricultural Equipment Technician, it is imperative that safety be taught on a continuous basis throughout the entire course.

SECTION ONE:.....SPRAYING EQUIPMENT..... 30 HOURS

A. Chemical Safety.....6 Hours

Outcome: Describe safe practices when working with and around agricultural chemicals.

1. Describe the rating system, which assesses agricultural chemical toxicity.
2. Describe safe transport, handling, and disposal of chemical containers.
3. Describe potential field application difficulties.
4. Describe environmental systems and clothing used to protect the operator when handling chemicals.

B. Sprayer Systems.....10 Hours

Outcome: Describe the operation of sprayer systems.

1. Describe the components of sprayer systems.
2. Explain the operation of a sprayer system.
3. Describe selected nozzles.
4. Interpret application charts.
5. Perform stationary calibrations.

C. Monitoring Equipment .....8 Hours

Outcome: Program electronic devices used in the agricultural spraying industry.

1. Describe controllers used to monitor and adjust sprayer functions.
2. Program and calibrate a sprayer electronic rate controller.
3. Diagnose operating problems of a sprayer rate controller.
4. Describe GPS applications in spraying.

D. Suspension Systems for Spraying .....6 Hours

Outcome: Explain suspension system features used on high-clearance sprayers.

1. Describe suspension systems used to support sprayer booms.
2. Describe selected suspension systems used to support sprayer chassis.
3. Describe the methods utilized to adjust wheel tread spacing on high clearance sprayers.

SECTION TWO: ..... AIR CONDITIONING AND HEATING SYSTEMS ..... 43 HOURS

A. Air Conditioning Fundamentals ..... 7 Hours

Outcome: Explain the operating principles of basic air conditioning systems.

1. Explain the thermodynamic principles related to air conditioning.
2. Explain the properties and handling precautions of refrigerants and refrigerant oils.
3. Identify the basic components of an air conditioning system.
4. Explain the operation of a cycling clutch air conditioning system using an expansion valve.

B. HVAC Control Systems (Heating, Ventilation and A/C) ..... 13 Hours

Outcome: Explain the operating principles of HVAC (Heating Ventilation and Air Conditioning) control systems.

1. Identify the components of an air conditioning control system.
2. Explain the operation of air conditioning control systems.
3. Identify the components of an air distribution system.
4. Explain the operation of an air distribution system.
5. Explain the procedure to test HVAC control system operation.
6. Describe agricultural HVAC processor driven controls.

C. Air Conditioning Testing, Service and Retrofitting ..... 23 Hours

Outcome: Diagnose and service air conditioning systems.

1. State the safety precautions required when servicing air conditioning systems.
2. Identify air conditioning service tools.
3. Perform air conditioning system diagnosis.
4. Perform air conditioning service within legislated guidelines.
5. Explain replacement procedures for defective air conditioning components.
6. Describe the procedure for retrofitting A/C hoses.
7. Describe the procedure for retrofitting receiver dryers.
8. Describe the procedure for retrofitting compressors.
9. Describe the procedure for retrofitting expansion valves.
10. Describe the use of alternative refrigerants.

SECTION THREE: .....POWER TRAIN II AND PREVENTIVE MAINTENANCE ..... 43 HOURS

A. Hydraulic and Power Take-Off Clutches ..... 8 Hours

Outcome: Identify, diagnose, and repair hydraulic and power take-off clutches.

1. Identify the components of a hydraulic clutch.
2. Explain the principles of operation of hydraulic clutches.
3. Perform service and diagnostic procedures of hydraulic clutches.
4. Identify types and designs of power take-offs.

5. Describe principles of operation power take-offs.
6. Perform service and diagnostic procedures for power take-offs.

B. Heavy Duty Transmissions and Four Wheel Drives ..... 22 Hours

Outcome: Identify and repair heavy duty mechanical transmissions and four wheel drive units.

1. Discuss heavy duty transmission nomenclature.
2. Identify design and types of transmissions.
3. Describe power flow, gear ratios, and shift procedures of transmissions.
4. Discuss service and diagnostic procedures of transmissions.
5. Discuss four wheel drive nomenclature and principles of operation.
6. Describe power flow and shift procedures through four wheel drive transfer units.
7. Describe power flow and shift procedures through four wheel drive axles.
8. Perform service and diagnostic procedures of four wheel drive power trains.

C. Preventive Maintenance ..... 6 Hours

Outcome: Explain typical maintenance programs used with agricultural equipment.

1. Explain the types of maintenance systems.
2. Explain the principles of preventive maintenance.
3. Explain the principles of predictive maintenance.

D. Failure and Fluid Analysis ..... 7 Hours

Outcome: Explain predictive maintenance procedures utilizing failure and fluid analysis.

1. Explain fluid (oil and coolant) analysis.
2. Interpret component failure analysis.

SECTION FOUR: ..... AGRICULTURAL HARVESTING EQUIPMENT ..... 46 HOURS

A. Forage Harvesting Equipment ..... 10 Hours

Outcome: Describe and adjust forage harvesters.

1. Describe the procedure of silage making.
2. Describe the operation of forage harvesters.
3. Perform adjustments and repairs to forage harvesters.
4. Describe repair procedures for metal detection systems.

B. Combines ..... 28 Hours

Outcome: Describe and adjust combines.

1. Describe the functions of a combine.
2. Describe the differences between conventional and rotary combines.
3. Describe components of conventional combines.
4. Describe components of rotary combines.
5. Identify the in-field trouble-shooting and adjustments of combines.

6. Perform feeder adjustments.
7. Perform thresher and separator adjustments.
8. Perform residue management adjustments.
9. Perform grain handling system component adjustments.

C. Yield Monitors ..... 8 Hours

Outcome: ***Explain the application of yield monitors as it pertains to precision farming techniques, taking field variability into account.***

1. Describe yield mapping equipment for combines.
2. Set-up a yield monitor utilizing a laptop computer and PC card interface.
3. Compare yield map details displaying raw data and smoothed data.
4. Query a yield map for average and site specific details.
5. Diagnose operating problems of a yield mapping system.

SECTION FIVE: ..... BRAKING SYSTEMS ..... 24 HOURS

A. Hydraulic Brakes System Fundamentals ..... 4 Hours

Outcome: ***Apply scientific principles to braking system operation.***

1. Explain braking principles with emphasis on hydraulic forces, friction and heat.
2. Describe the properties and handling procedures of brake fluid and hydraulic oil.
3. Identify common power assist braking systems.
4. Explain the principles of operation for selected brake booster systems.

B. Hydraulic Brake Systems (Drum and Disc) ..... 4 Hours

Outcome: ***Explain the operation of hydraulic drum and disc brake systems.***

1. Explain the principles of operation of drum brake systems.
2. Explain the principles of operation of disc brake systems.
3. Explain the construction and operation of master cylinders.
4. Explain the purpose and construction of brake lines and hoses.
5. Explain the construction and operation of wheel cylinders and callipers.
6. Explain the purpose and operation of valves.

C. Hydraulic Brake System Diagnosis and Service ..... 4 Hours

Outcome: ***Service hydraulic drum and disc brake systems.***

1. List safety responsibilities required when servicing and repairing brake systems.
2. Diagnose brake systems faults.
3. Service a drum brake assembly.
4. Service a disc brake assembly.
5. Describe agricultural brake flushing and bleeding procedures on hydraulic brake systems.

D. Agricultural Braking Systems Fundamentals and Service ..... 12 Hours

Outcome: Explain and service various agricultural braking systems.

1. Describe selected agricultural based braking systems.
2. Describe selected agricultural hydraulic brake control systems.
3. Describe common brake nomenclature and safety procedures.
4. Describe multidisc wet brake systems.
5. Describe agricultural ABS braking and electronic controls.
6. Describe selected agricultural park brakes and controls.
7. Disassemble/assemble selected agricultural brake components.
8. Adjust agricultural park and service brake systems.
9. Identify common agricultural brake component failures.
10. Identify common agricultural hydraulic brake control components.

SECTION SIX:..... SEEDING AND PRECISION FARMING SYSTEMS ..... 54 HOURS

A. GPS Mapping ..... 12 Hours

Outcome: Explain the application of GPS mapping as it pertains to precision farming techniques, taking field variability into account.

1. Describe GPS system operation relating to space, user, and control components.
2. Describe datum measuring systems and units used in GPS.
3. Record waypoints and lines in a field mapping exercise with a handheld GPS unit.
4. Create a map on a computer after unloading information from a GPS unit.
5. Assess selected types of differential correction systems used to enhance GPS accuracy.

B. GPS Steering Guidance Systems ..... 7 Hours

Outcome: Identify GPS steering guidance systems.

1. Identity the types of steering guidance systems.
2. Describe the operation of GPS steering guidance systems.
3. Describe the setup of a guidance system.

C. Seeding Equipment ..... 23 Hours

Outcome: Describe and adjust seeding equipment.

1. Describe seeding theory.
2. Identify selected types of seeding equipment.
3. Describe the operating procedures of seeding equipment.
4. Identify selected types of soil openers and their seed placement.
5. Describe styles of seed metering systems.
6. Describe types of air stream loading and manifold systems.
7. Describe styles of packing systems and their applications.
8. Compare air systems to gravity systems.

9. Calculate in-field calibrations.
10. Perform stationary calibrations.
11. Describe repairs to seeding equipment (planters).
12. Describe repairs to air seeding equipment.
13. Perform adjustments and repairs to air seeding equipment.

D. Variable Rate Application ..... 8 Hours

Outcome: ***Explain the use of variable rate application as it pertains to precision farming techniques, taking field variability into account.***

1. Describe variable rate technology (VRT) for crop inputs.
2. Compare the differences between manual variable rate and map based variable rate systems.
3. Describe controller functions relating to setup, calibration, sensor input and operator readout information.
4. Program a variable rate monitor to control an air drill.
5. Calibrate a variable rate applicator for seed or fertilizer.
6. Diagnose operating problems of a variable rate applicator.

E. Monitors and Sensors ..... 4 Hours

Outcome: ***Identify features of monitoring systems and controller area networks.***

1. Describe the function of performance monitors.
2. Describe the operating principles of ISO compliant communication.
3. Record diagnostic and warning messages produced by the ISO compliant communication system.

FOURTH PERIOD TECHNICAL TRAINING
AGRICULTURAL EQUIPMENT TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE: ..... HYDRAULICS II ..... 114 HOURS

A. Hydraulic Principles ..... 9 Hours

Outcome: Explain principles of hydraulics.

1. Explain the principles of hydraulic energy transfer.
2. State the characteristics of hydraulic oil.
3. Explain common hydraulic contamination control methods.

B. Hydraulic Pump Fundamentals ..... 9 Hours

Outcome: Identify common hydraulic pumps.

1. Explain common hydraulic pump configurations.
2. Explain gear pump operating principles.
3. Explain vane pump operating principles.
4. Explain piston pump operating principles.

C. Hydraulic Pump Service ..... 12 Hours

Outcome: Diagnose and repair common hydraulic pumps.

1. Explain start up procedures and precautions.
2. Service a gear pump.
3. Service a vane pump.
4. Service a piston pump.

D. Hydraulic Actuator Fundamentals ..... 6 Hours

Outcome: Identify hydraulic cylinders and motors.

1. Explain the operating principles of hydraulic cylinders.
2. Explain the operating principles of hydraulic motors.

E. Hydraulic Actuator Service ..... 9 Hours

Outcome: Service hydraulic cylinders and motors.

1. Service hydraulic cylinders.
2. Service hydraulic motors.

F. Hydraulic Valve II ..... 18 Hours

Outcome: Service hydraulic pressure, flow and directional control valves.

1. Explain the operation and service procedures of hydraulic pressure control valves.
2. Explain the operation and service procedures of hydraulic flow control valves.
3. Explain the operation and service procedures of hydraulic directional control valves.
4. Explain the operation and service procedures of directional control valve accessories.
5. Explain methods used to connect multiple directional control valves.

G. Hydraulic System Types ..... 18 Hours

Outcome: Analyze common mobile equipment hydraulic systems.

1. Interpret common mobile equipment hydraulic system schematics.
2. Explain the operation of mobile open centre hydraulic systems.
3. Explain the operation of mobile closed centre hydraulic systems.
4. Explain the operation of a mobile hydrostatic transmission hydraulic system.

H. Hydraulic System Testing and Service ..... 18 Hours

Outcome: Diagnose common mobile equipment hydraulic systems.

1. Perform visual inspection and operational tests on common hydraulic systems.
2. Perform pressure and flow testing on common hydraulic systems.
3. Determine hydraulic system faults.

I. Electro-Hydraulics ..... 15 Hours

Outcome: Analyze basic electrical and electronically controlled hydraulic systems.

1. Explain the operation principles of electrically controlled hydraulic system components.
2. Explain the operating principles of electronically controlled hydraulic system components.
3. Explain joystick and pulse width modulated control systems.
4. Diagnose electro hydraulic system faults.

SECTION TWO: ..... STEERING AND SUSPENSION SYSTEMS AND ACCESSORIES ..... 33 HOURS (SPECIFIC TO OFF ROAD) & APPRENTICESHIP

A. Wheeled Equipment Steering Fundamentals and Service ..... 6 Hours

Outcome: Diagnose and service off-road equipment steering systems.

1. Identify common off-road steering configurations and applications.
2. Identify full time power steering system components.
3. Explain the operation of common off-road power steering systems and components.
4. Explain off-road power steering system diagnostic and service procedures.
5. Identify skid steering system components.
6. Explain the operation of a skid steering system.
7. Explain skid steering system diagnostic and service procedures.

B. Suspension System Fundamentals and Service ..... 5 Hours

Outcome: Explain off-road suspension system diagnostic and service procedures.

1. State the functions and applications of common off-road suspension systems.
2. Explain the operation of a motor scraper cushion hitch system.
3. Explain cushion hitch diagnostic and service procedures.
4. Explain the operation of common haul truck suspension systems.
5. Explain common haul truck suspension system diagnostic and repair procedures.

C. Off-Road Equipment Accessories and Attachments ..... 5 Hours

Outcome: Service and maintain accessories and attachments used with off-road equipment.

1. Explain the functions and operating principles of operator protective structures.
2. Explain operator protective structures in regards to service and maintenance precautions.
3. Identify and explain the purpose of automatic fire suppression systems used on off-road equipment.
4. Identify and explain the functions of common ground engaging tools and tool mounting components.
5. Explain the procedures required to service common ground engaging tools.
6. Explain the operating principles and service procedures required for common types of winches.

D. Off-Road Electrical Circuit Fundamentals ..... 8 Hours

Outcome: Explain the operation of typical off-road equipment electrical and warning circuits.

1. Explain the operation of off-road equipment lighting circuits.
2. Explain the operation of off-road equipment accessory circuits.
3. Explain the operation of audible and visual warning devices.
4. Explain multiplexing systems in off road equipment

E. Off-Road Electrical Circuit Service ..... 6 Hours

Outcome: Diagnose and repair off-road equipment electrical circuits.

1. Perform basic test procedures on off-road equipment lighting circuits.
2. Perform basic test procedures on off-road equipment accessory circuits.
3. Explain precautions when servicing electronic dash systems.

F. Workplace Coaching Skills ..... 1 Hour

Outcome: Display coaching skills.

1. Describe coaching skills used for training apprentices.
    a) Identifying the point of the lesson.
    b) Linking the lesson.
    c) Demonstrating a new skill.
    d) Providing the opportunity to practice a skill.
    e) Giving feedback to the learner.
    f) Assessing the apprentices learning progress.

G. Advisory Network ..... 1 Hour

Outcome: Describe the advisory network.

1. Explain the role and purpose of the advisory network, local apprenticeship committee, and provincial apprenticeship committee.

H. Interprovincial Standards ..... 1 Hour

Outcome: Discuss Red Seal/Interprovincial Standards.

1. Describe the National Occupational Analysis (NOA).
2. Describe the relationship between the NOA and Red Seal / Interprovincial examinations.
3. Discuss the roles of federal and provincial government in the development of Red Seal standards.
4. Discuss the role of industry in the development of Red Seal standards.
5. Explain the intent of the Red Seal exam as it relates to interprovincial mobility.
6. Describe sources of information on Red Seal standards and practice examination

SECTION THREE: ..... POWER TRAIN (SPECIFIC TO OFF ROAD) ..... 93 HOURS

A. Gearing Principles ..... 3 Hours

Outcome: Explain basic gearing principles.

1. Define gear terminology.
2. Explain gear relationships with regards to ratios and input/output direction.
3. Identify common gear types and applications.

B. Torque Converter Fundamentals and Service ..... 9 Hours

Outcome: Diagnose and repair common off-road equipment torque converters.

1. Describe the function and concepts of fluid converters.
2. Describe the components and operation of torque converters.
3. Explain the operation of a torque divider.
4. Explain basic torque converter mounting, diagnostic and repair procedures.

C. Powershift and Automatic Transmission Mechanical/Electronic Components ..... 14 Hours

Outcome: Explain the operation of powershift and automatic transmissions mechanical components.

1. Compare functions and applications of powershift and automatic transmissions.
2. Explain gearing principles of single and multiple planetary gear seats.
3. Explain the operation of a typical planetary type transmission.
4. Explain the operation of typical countershaft type powershift/automatic transmissions.

D. Powershift and Automatic Transmission Control and Shifting ..... 9 Hours

Outcome: Explain the operation of powershift and automatic transmission shift control mechanisms.

1. Explain the operation of hydraulic shift control systems for powershift transmissions.

2. Explain the operation of hydraulic shift control systems for automatic transmissions.
3. Explain the operation of electronic shift control systems for automatic transmissions.

E. Hydraulic Retarder Fundamentals ..... 3 Hours

Outcome: Explain the operating principles for off-road equipment hydraulic retarders.

1. Identify the components of a typical off-road equipment hydraulic retarder.
2. Explain the operation of a typical off-road equipment hydraulic retarder.

F. Powershift and Automatic Transmission Testing and Service ..... 9 Hours

Outcome: Diagnose and service powershift and automatic transmissions.

1. Perform powershift and automatic transmission visual inspections and operational tests.
2. Perform powershift and automatic transmission hydraulic shift control system testing.
3. Perform powershift and automatic transmission electronic shift control system testing.
4. Explain the procedures to remove and reinstall a powershift and automatic transmission.

G. Tracked Equipment Steering Fundamentals and Service ..... 10 Hours

Outcome: Explain tracked equipment steering system diagnostic and service procedures.

1. Explain the operation of a steering clutch and brake crawler tractor steering system.
2. Explain the diagnostic and service procedures for a steering clutch and brake crawler tractor steering system.
3. Explain the operation of a hydrostatic crawler tractor steering system.
4. Explain diagnostic and service procedures for a hydrostatic crawler tractor steering system.
5. Explain the operation of a differential type crawler tractor steering system.
6. Explain the diagnostic and service procedures for a differential type crawler tractor steering system.

H. Undercarriage Systems Fundamentals and Service ..... 11 Hours

Outcome: Explain diagnostic and service procedures for tracked equipment undercarriage and related components.

1. Describe the functions, applications and configurations of undercarriage systems.
2. Explain the functions and operation of the components of typical undercarriage systems.
3. Perform undercarriage inspection and adjustment procedures.
4. Explain the procedures required for safely removing and replacing undercarriage components.
5. Explain procedures for remanufacturing undercarriage components.

I. Final Drive Fundamentals and Service (Off Road) ..... 10 Hours

Outcome: Explain diagnostic and service procedures for off-road equipment final drive systems.

1. Describe the functions, applications, and configurations of drive systems.
2. Explain the operation of wheeled equipment final drive systems.
3. Explain the fundamentals of AC drive systems.
4. Explain the safety precautions when servicing units equipped with AC drive systems.
5. Explain the operation of tracked equipment final drive system.

6. Explain maintenance and service procedures for final drive systems.

J. Drive Axle and Differential Fundamentals and Service (Off Road) ..... 12 Hours

Outcome: Repair drive axle and differential assemblies.

1. State the functions of single reduction drive axle assemblies.
2. Identify single reduction drive axle components.
3. Explain the operating principles of a single reduction drive axle and differential assembly.
4. Identify common types of differential units used in the trade.
5. Explain the lubrication of a single reduction drive axle.
6. Diagnose a drive axle and differential assembly for operational faults.
7. Explain drive axle and differential assembly removal and replacement procedures.
8. Overhaul a typical drive axle and differential assembly to manufacturer's specifications.

K. Clutch Fundamentals and Service ..... 3 Hours

Outcome: Service and diagnose common clutch types.

1. Explain the operation and maintenance of over-centre clutches.
2. Explain the operation principles of special application clutches: overrunning, dog, cone and bevel, electromagnetic.

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